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The Other-Race Effect in Infancy: Evidence Using a Morphing Technique

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Human adults are more accurate at discriminating faces from their own race than faces from another race. This *other-race effect* (ORE) has been characterized as a reflection of face processing specialization arising from differential experience with own-race faces. We examined whether 3.5-month-old infants exhibit ORE using morphed faces on which adults had displayed a crossover ORE (i.e., Caucasians performed better on Caucasian faces and Asians performed better on Asian faces). In this experiment, Caucasian infants who had grown up in a predominantly Caucasian environment discriminated 100% Caucasian faces from 70% Caucasian/30% Asian morphed faces but failed to discriminate between the corresponding 100% Asian and 70% Asian/30% Caucasian faces. Thus, 3.5-month-olds exhibited evidence of ORE. These results indicate that at least by 3.5 months of age, infants have attained enough face processing expertise to process familiar-race faces in a different manner than unfamiliar-race faces.

Humans rely heavily on face processing to interact effectively with other humans in their environment. This reliance is reflected in the high level of face processing expertise that human adults generally exhibit. For instance, adults can readily discriminate among and remember hundreds of faces for long durations (e.g., Bahrick, Bahrick, & Wittlinger, 1975). One of the significant issues in psychology is the question of how this expertise develops (Carey, 1992).

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An area of research that has addressed the issue of face processing expertise concerns the *other-race effect* (ORE). ORE refers to the fact that humans are better at recognizing faces from their own race than faces from another race (Chance & Goldstein, 1996; Meissner & Brigham, 2001). This effect has been found under a variety of circumstances, ranging from perceptual encoding tasks (e.g., Walker & Tanaka, 2003) to memory tasks involving delays over 4 days (Slone, Brigham, & Meissner, 2000), and even in more naturalistic eyewitness memory paradigms (Wright, Boyd, & Tredoux, 2001).

One explanation for ORE was based on the hypothesis that there may be inherent physical differences in facial features between races that make discrimination easier within some races than others (Goldstein & Chance, 1979). This explanation has been found wanting, however, because there is no evidence to suggest on the basis of either anthropometric (e.g., Goldstein & Chance, 1976) or behavioral data (e.g., Goldstein & Chance, 1978) that faces from one race are physically more homogenous than faces from other races.

Significant evidence against the inherent physical differences hypothesis also comes from the crossover nature of ORE. For example, Walker and Tanaka (2003) found that Caucasians are better at processing Caucasian faces than Asian faces, whereas Asians in the same study exhibited the opposite pattern of performance on the same stimuli. The fact that the participants of each race exhibited ORE indicates that there are no inherent physical characteristics of a particular race that make processing faces from that race more difficult than processing faces from other races.

The more likely explanation for ORE is that humans adapt to the environment in which they are embedded and thus learn to process faces around them more readily than faces that are less available in their environment (e.g., Furl, Phillips, & O'Toole, 2002; Levin, 2000; Meissner & Brigham, 2001; Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; Sangrigoli & de Schonen, 2004a, 2004b; Valentine, 1991; Valentine, Chiroro, & Dixon, 1995). In other words, according to this hypothesis, experience with a particular race engenders the processing of faces from that race to a greater degree or in a different manner (see Levin, 2000; Tanaka, Kiefer, & Bukach, 2004). This presumably allows the perceiver to interact more effectively with members of the familiar race.

If experience is the critical factor that engenders ORE, then the question arises as to when in life this level of experience is reached (Chance, Turner, & Goldstein, 1982; Corenblum & Meissner, 2006; Sangrigoli & de Schonen, 2004a; Sangrigoli, Pallier, Argenti, Ventureyra, & de Schonen, 2005). To our knowledge, only one study has addressed the issue of differential discrimination of own-race versus other-race faces in infancy. Sangrigoli and de Schonen (2004b) found that 3-month-old Caucasian infants discriminated between Caucasian faces but did not discriminate between Asian faces. Thus, they obtained evidence consistent with the proposition that even by 3 months of age infants have had enough experience with faces from a particular race to exhibit ORE. However, in that study, there was

no evidence to indicate whether or not the faces from the different races were distributed in the same manner across physical similarity space. Thus, it is possible that the poorer performance on the Asian faces may have been due to the fact that the Asian faces used in their study happened to be physically more similar to each other than the Caucasian faces. Sangrigoli and de Schonen (2004b) reported that exposing Caucasian infants to Asian faces during the experimental session did lead to the subsequent discrimination of Asian faces, thereby indicating that any similarity differences that there may have been were not enough to prevent discrimination between Asian faces. Nevertheless, to obtain clear evidence of ORE, it would be helpful to control similarity characteristics of the stimuli used in the ORE study to minimize inherent discriminability differences in the faces from different races.

One way to get around the problem of differential levels of similarity in stimulus sets is to use a *morphing technique*. Morphing allows the generation of face stimuli whose distance from other faces in face space can be specified at least within the limits posed by the morphing technique (Busey, 1998). In an ORE study, morphing can be used to control physical similarity among the different-race faces. If an ORE is obtained with such stimuli, then it is more likely that there is a genuine difference in the discriminability of faces from different races.

However, morphing by itself cannot be relied on to completely control similarity relations because it is an open question as to whether morphing controls for physical similarity in a manner that is neutral with respect to the face space of people from different races. In other words, although morphing may control physical similarity among faces from different races, such a set of faces may or may not be controlled for perceptual similarity of faces, especially to participants from different races. To empirically assess whether discriminability differences had been accounted for when using a set of faces, one has to examine whether there is a crossover effect; that is, better performance by Race A participants on Race A faces than on Race B faces and the converse pattern of performance by Race B participants.

Walker and Tanaka (2003) took pairs of Caucasian and Asian faces and created *intermediate morphs* with distance in physical similarity space from the parent Caucasian and Asian faces that could be specified. Thus, a 70% Asian/30% Caucasian face could be characterized as being equidistant in face space from the parent Asian face as a 30% Asian/70% Caucasian face is from the corresponding parent Caucasian face (at least within the limits imposed by the algorithm used to morph faces). With these physical similarity relations thus controlled, Walker and Tanaka (2003) were able to find a genuine crossover ORE: Caucasian adults were more accurate on Caucasian faces and Asian adults were more accurate on Asian faces. Thus, Walker and Tanaka not only attempted to control for physical differences by using morphed stimuli, but they also empirically validated their technique by obtaining a crossover ORE with adults.

In the experiments reported here, we used stimuli from the Walker and Tanaka (2003) study to examine whether 3.5-month-olds also exhibit ORE. The use of the Walker and Tanaka morphed stimuli enabled us to use Caucasian and Asian stimuli

with physical similarity relations that had been controlled and on which adults exhibited clear evidence of ORE. Specifically, we examined whether 3.5-month-old Caucasian infants exhibit ORE by determining whether they discriminate 100% Caucasian faces from 70% Caucasian/30% Asian faces but fail to discriminate the corresponding 100% Asian faces from 70% Asian/30% Caucasian faces.

METHOD

Participants

Twenty-four full-term 3.5-month-olds (15 females; *M* age = 105.33 days, *SE* = 1.78 days) participated in this experiment. They were recruited using birth announcements in local newspapers and by word of mouth. Infants in this experiment were all Caucasians from middle-class backgrounds. An additional 9 infants were excluded from this study for crying ($n = 8$) or for failing to sample both test stimuli (i.e., 95% or greater looking to one face; $n = 1$).

Stimuli

Three different female Asian–Caucasian face pairs and the corresponding 70%/30% morphs used by Walker and Tanaka (2003) were used in this experiment (see Figure 1 for an example). These stimuli and the manner in which they were created were described in detail by Walker and Tanaka. Briefly, the program Morph 2.5 was used to create morphs based on the process described by Beale and Keil (1995). The 70%/30% faces were created by using a warping algorithm to move 30% along the pixel luminance vector that connected corresponding control points in the Asian and Caucasian parent faces. These stimuli were presented on a computer monitor and roughly subtended 17.85° × 13.92° from the infants' position.

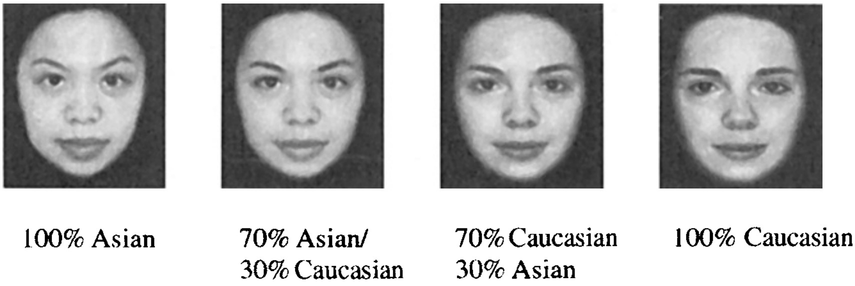

FIGURE 1 Examples of the stimuli used.

Apparatus and Procedure

The apparatus and procedure were the same as those used in previous studies (e.g., Bertin & Bhatt, 2006). Infants were seated approximately 45 cm in front of a computer monitor. The monitor was in a darkened chamber and the only illumination in this chamber came from the monitor. Black cloth, extending from floor to ceiling, prevented the infants from viewing anything else in the room. A Sony CCD-FX430 camera, located on top of the monitor with only its lens sticking out of a hole in the curtain surrounding the monitor, was used to record infants' look directions and durations. A TV monitor, DVD recorder, and a computer, located outside the test chamber, were used to conduct the procedure and record infants' behavior. A computer and Macromedia Authorware software were used to record infants' looks during the experimental session, calculate habituation criteria, and manage stimulus presentations and trial changes.

An infant-control procedure that was used in many previous studies was used in this experiment (e.g., Bertin & Bhatt, 2006; Horowitz, Paden, Bhana, & Self, 1972). Infants were repeatedly exposed to a face until their look durations to this face declined to a criterion level and then they were tested for their preference between this face and a morphed face. Each habituation and test trial began with the presentation of an attention getter—rapidly alternating square and circle colored patterns—in the middle of the monitor screen. Once the infant's attention was directed to this attention getter, the experimenter pressed a key to present two images, one on each side of the monitor, equidistant from the center. During the habituation trials, two identical copies of a 100% Caucasian or 100% Asian face were presented. The images remained on the monitor until the infant looked away for more than 2 sec or until a total of 60 sec had elapsed. Such habituation trials continued until the infant's average look duration during three consecutive trials was less than 50% of his or her average look duration during the first three trials. Immediately after the last habituation trial, infants were tested on two 10-sec trials, in which the familiar face was paired with its corresponding 70%/30% morph. The right–left location of the familiar face in the first test trial was randomly determined and counterbalanced across participants in each condition, and this location was switched from the first to the second test trial.

Half of the infants were habituated to a 100% Caucasian face and tested with this face paired with its corresponding 70% Caucasian/30% Asian morph. The other half of the infants were habituated to a 100% Asian face and tested with this face paired with its corresponding 70% Asian/30% Caucasian morph. We chose to habituate infants only to the 100% faces rather than counterbalance habituation stimuli with the morphed faces because we wanted to confine infants' experience during habituation to "pure" race faces. We were concerned that exposure to morphed stimuli that contained features from both races prior to being tested might mitigate ORE. Also note that the procedure used in this study was generally the

same as the one used by Sangrigoli and de Schonen (2004b), except that a between-subject design was used here, whereas Sangrigoli and de Schonen (2004b) tested the same infants on both Caucasian and Asian faces.

An observer who was unaware of the location of the novel face coded infants' looks during the test trials offline. The speed of the DVD player was reduced to 25% of normal speed during coding. Stopwatches were used to record infants' looks to the left and to the right. The total look duration to each side during each test trial was used to measure infants' preference (as discussed further later). The performance of 5 infants was coded by another trained observer, and the interobserver reliability was .98.

RESULTS

Infants' look durations during habituation are displayed in Table 1. A race (Caucasian face, Asian face) × trial block (first three, last three) analysis of variance revealed only a main effect of trial block, $F(1, 22) = 46.35$, $p < .001$. Thus, as required by the procedure used in this experiment, infants' look durations declined from the first three to the last three habituation trials. Moreover, the fact that neither the race main effect, $F(1, 22) = .83$, $p = .37$, nor the Race ×Trial Block interaction, $F(1, 22) = 1.86$, $p = .19$, was significant indicates that the participants' habituation pattern did not differ as a function of whether they were habituated to Caucasian or Asian faces. This conclusion was also supported by the fact that the infants in the two conditions did not differ in the number of trials required to reach habituation, $t(22) = .29$, $p = .77$ (see Table 1).

Table 1 also displays infants' performance during the test trials. As in previous studies (e.g., Bhatt, Bertin, Hayden, & Reed, 2005), we computed a novelty preference score for each infant to evaluate performance during the test trials. This score was derived by dividing the look duration toward the novel face by the total look duration toward both the novel and familiar face and multiplying this ratio by 100. A group mean novelty preference score that is greater than the chance level of 50% indicates discrimination, whereas a score that is not different from 50% indicates a lack of discrimination. Infants habituated to the Caucasian faces exhibited discrimination: Their novelty preference score was significantly greater than the chance level of 50%, $t(11) = 2.67$, $p < .03$. In contrast, infants habituated to Asian faces failed to discriminate: Their novelty preference score was not different from the chance level of 50%, $t(11) = -.45$, $p > .6$. Moreover, a t test indicated that the score of infants in the Caucasian condition was significantly greater than the score of the infants in the Asian condition, $t(22) = 1.82$, $p < .05$. These results suggest that the Caucasian infants in our study discriminated between 100% Caucasian and 70% Caucasian/30% Asian faces, but did not discriminate between the corresponding 100% Asian faces and 70% Asian/30% Caucasian faces. Thus, infants exhibited evidence of ORE.

TABLE 1
Mean and Standard Error of Fixation Duration During Habituation Trials, Number of Trials to Habituation, Total Look Durations and Percentage Novelty Preference Exhibited During Test Trials in This Study

	First Three Habituation Trials (sec)		Last Three Habituation Trials (sec)		Number of Trials to Habituation	
	M	*SE*	*M*	*SE*	*M*	*SE*
Asian	40.87	6.81	12.32	2.14	7.08	0.66
Caucasian	31.19	4.83	12.18	2.84	7.33	0.53

Look Durations (Sec) During Test Trials

	Familiar				Novel			
	M	*SE*	*Min*	*Max*	*M*	*SE*	*Min*	*Max*
Asian	7.23	1.09	1.32	13.82	5.95	0.83	1.89	11.31
Caucasian	5.92	0.67	2.64	10.57	9.29	0.92	5.02	15.80

Preference (%) for Novel Pattern During Test

	M	*SE*	*N*	*t (vs. Chance)*	*p (Two-tailed)*
Asian	47.20	6.18	12	−0.45	.66
Caucasian	60.58	3.96	12	2.67	.02

DISCUSSION

Caucasian 3.5-month-old infants exhibited ORE with stimuli that were morphed to control for similarity and on which a crossover ORE was seen with adults. The finding that early in life infants exhibit ORE indicates that specialization induced by exposure to a particular kind of face does not take long to develop.

Valentine (1991) proposed a multidimensional face processing model that explained ORE based on differential distribution of own- versus other-race faces. This model specifically proposed that own-race faces are distributed more widely in face space than other-race faces. Computational modeling has validated this kind of explanation of ORE (Caldara & Abdi, 2006). The ORE exhibited by infants in this study and in Sangrigoli and de Schonen (2004b) suggests that even by 3 months of age, infants' face space is being organized in the manner hypothesized by Valentine (1991). Better discrimination of own-race than other-race faces by infants is consistent with the proposition that infants' face space also has own-race faces distributed more widely than other-race faces.

Furl et al. (2002) also adapted the multidimensional face space framework to explain ORE. They argued that the best accounting of ORE is provided by representational systems that learn with exposure to faces in such a way that the perceptual space is optimized to encode the distinctions relevant to own-race faces. In other words, according to Furl et al., exposure to own-race faces "warps" the multidimensional face space, such that the features that are helpful to distinguish among own-race faces are given more weight, thus rendering own-race discrimination easier and other-race distinctions harder. This study does not directly address this model. However, this study is consistent with the model in suggesting that there is enough exposure to own-race faces early in life for infants to begin to treat own-race faces differently than other-race faces. This processing difference may be engendered by the perceptual warping process hypothesized by Furl et al.

Research suggests that adults encode different kinds of information from own-race faces than from other-race faces (e.g., Levin, 2000; Tanaka et al., 2004). For instance, adults tend to process own-race faces at a more subordinate level than other-race faces (Tanaka, Droucker, & Meyers, 2007). It is not clear, however, whether infants also derive different kinds of information from own-race faces than from other-race faces. Bar-Haim, Ziv, Lamy, and Hodes (2006) and Kelly et al. (2007; Kelly et al., 2005) have found that when own-race and other-race faces are presented side by side, 3-month-old infants prefer to look at own-race faces. However, longer looking toward own-race faces may or may not translate into the processing of qualitatively different kinds of information from different race faces. Thus, one goal of future research should be to understand the nature of processing that is triggered by own-race versus other-race faces and the nature of the development of these different kinds of processing.

The finding that even by 3.5 months of age infants exhibit ORE indicates that at least one aspect of face processing expertise develops early in life. At the same time, however, other research (Pascalis, de Haan, & Nelson, 2002) suggests that young infants are not as specialized as older infants and adults in the processing of faces, at least faces from other species. Nor are young infants sensitive to certain kinds of relational information in faces to which older infants and adults are sensitive (e.g., Bertin & Bhatt, 2004; Bhatt et al., 2005; but see Mondloch, Leis, & Maurer, 2006). Together, these findings suggest that, although certain facets of face processing expertise are seen early in life, not all are, and one of the tasks for future research is to understand how these various aspects of face processing develop and interact with each other.

The results of this study are consistent with the findings of Sangrigoli and de Schonen (2004b) that 3-month-olds Caucasian infants exhibit ORE. Sangrigoli and de Schonen used nonmorphed stimuli and did not attempt to control for similarity, whereas this study used morphed stimuli in an attempt to equate physical similarity among faces from different races. However, a limitation of this study is the uncertainty concerning morphing and similarity relations pertaining to infants'

processing of faces. Adults in the Walker and Tanaka (2003) study (from which the current stimuli were borrowed) exhibited crossover ORE, in that Caucasians performed better on Caucasian stimuli and Asians on Asian stimuli. Thus, there is evidence that the stimuli created by the morphing were such that there were no discriminability differences that made faces from one race inherently more difficult than faces for the other race (at least enough to prevent crossover ORE). It is not clear, however, whether the distribution of these stimuli in face space is the same in the case of infants as with adults and whether equivalent similarity had been established in the faces from the different races. Given this uncertainty, it would be helpful to obtain crossover effects in infancy like the one documented with adults by Walker and Tanaka (2003) to obtain stronger evidence of ORE in infancy.

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REFERENCES

Bahrick, H. P., Bahrick, O. O., & Wittlinger, R. P. (1975). Fifty years of memory for names and faces: A cross-sectional approach. *Journal of Experimental Psychology: General, 104,* 54–75.

Bar-Haim, Y., Ziv, T., Lamy, D., & Hodes, R. M. (2006). Nature and nurture in own-race face processing. *Psychological Science, 17,* 159–163.

Beale, J. M., & Keil, F. C. (1995). Categorical effects in the perception of faces. *Cognition, 57,* 217–239.

Bertin, E., & Bhatt, R. S. (2004). The Thatcher illusion and face processing in infancy. *Developmental Science, 7,* 431–436.

Bertin, E., & Bhatt, R. S. (2006). Three-month-old infants' sensitivity to orientation cues in the 3-D depth plane. *Journal of Experimental Child Psychology, 93,* 45–62.

Bhatt, R. S., Bertin, E., Hayden, A., & Reed, A. (2005). Face processing in infancy: Developmental changes in the use of different kinds of relational information. *Child Development, 76,* 169–181.

Busey, T. A. (1998). Physical and psychological representation of faces: Evidence from morphing. *Psychological Science, 9,* 476–483.

Caldara, R., & Abdi, H. (2006). Simulating the "other-race" effect with autoassociative neural networks: Further evidence in favor of the face-space model. *Perception, 35,* 659–670.

Carey, S. (1992). Becoming a face expert. *Philosophical Transactions: Biological Sciences, 335,* 95–102.

Chance, J. E., & Goldstein, A. G. (1996). The other-race effect and eyewitness identification. In S. L. Sporer, R. S. Malpass, & G. Koehnken (Eds.), *Psychological issues in eyewitness identification* (pp. 153–176). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Chance, J., Turner, A., & Goldstein, A. (1982). Development of differential recognition of own- and other-race faces. *Journal of Social Psychology, 97,* 29–37.

Corenblum, B., & Meissner, C. A. (2006). Recognition of faces of ingroup and outgroup children and adults. *Journal of Experimental Child Psychology, 83,* 187–206.

Furl, N., Phillips, P. J., & O'Toole, A. J. (2002). Face recognition algorithms and the other-race effect: Computational mechanisms for a developmental contact hypothesis. *Cognitive Science, 26,* 797–815.

Goldstein, A. G., & Chance, J. E. (1976). Measuring psychological similarity of faces. *Bulletin of the Psychonomic Society, 7,* 407–408.

Goldstein, A. G., & Chance, J. E. (1978). Judging face similarity in own and other races. *Journal of Psychology, 98,* 185–193.

Goldstein, A. G., & Chance, J. E. (1979). Do "foreign" faces really look alike? *Bulletin of the Psychonomic Society, 13,* 111–113.

Horowitz, F. D., Paden, L., Bhana, K., & Self, P. (1972). An infant-control procedure for studying infant visual fixation. *Developmental Psychology, 7,* 90.

Kelly, D. J., Liu, S., Ge, L., Quinn, P. C., Slater, A. M., Lee, K., et al. (2007). Cross-race preferences for same-race faces extend beyond the African versus Caucasian contrast in 3-month-old infants. *Infancy, 11,* 87–95.

Kelly, D. J., Quinn, P. C., Slater, A. M., Lee, K., Gibson, A., Smith, M., et al. (2005). Three-month-olds, but not newborns, prefer own-race faces. *Developmental Science, 8,* F31–F36.

Levin, D. T. (2000). Race as a visual feature: Using visual search and perceptual discrimination tasks to understand face categories and the cross-race recognition. *Journal of Experimental Psychology: General, 129,* 559–574.

Meissner, C. A., & Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. *Psychology, Public Policy, and Law, 7,* 3–35.

Mondloch, C. J., Leis, A., & Maurer, D. (2006). Recognizing the face of Johnny, Suzy, and me: Insensitivity to the spacing among features at 4 years of age. *Child Development, 77,* 234–243.

Pascalis, O., de Haan, M., & Nelson, C. A. (2002). Is face processing species-specific during the first year of life? *Science, 296,* 1321–1323.

Quinn, P. C., Yahr, J., Kuhn, A., Slater, A. M., & Pascalis, O. (2002). Representation of the gender of human faces by infants: A preference for female. *Perception, 31,* 1109–1121.

Sangrigoli, S., & de Schonen, S. (2004a). Effect of visual experience on face processing: A developmental study of inversion and non-native effects. *Developmental Science, 7,* 74–87.

Sangrigoli, S., & de Schonen, S. (2004b). Recogntion of own-race and other-race faces by three-month-old infants. *Journal of Child Psychology and Psychiatry, 45,* 1219–1227.

Sangrigoli, S., Pallier, C., Argenti, A. M., Ventureyra, V. A. G., & de Schonen, S. (2005). Reversability of the other-race effect in face recogntion during childhood. *Psychological Science, 16,* 440–444.

Slone, A. E., Brigham, J. B., & Meissner, C. A. (2000). Social and cognitive factors affecting the own-race advantage in Whites. *Basic and Applied Social Psychology, 22,* 71–84.

Tanaka, J. W., & Droucker, D. (2007). Behavioural plasticity and the other race effect in face recognition: A test of the perceptual expertise hypothesis. Under review..

Tanaka, J. W., Kiefer, M., & Bukach, C. M. (2004). A holistic account of the own-race effect in face recognition: Evidence from a cross-cultural study. *Cogntion, 93,* B1–B9.

Valentine, T. (1991). A unified account of the effects of distinctiveness, inversion, and race in face recognition. *Quarterly Journal of Experimental Psychology A, 43,* 161–204.

Valentine, T., Chiroro, P., & Dixon, R. (1995). An account of the own-race bias and the contact hypothesis based on a "face space" model of face recognition. In T. Valentine (Ed.), *Cognitive and computational aspects of face recognition: Explorations of face space* (pp. 69–94). London: Routledge.

Walker, P. M., & Tanaka, J. W. (2003). An encoding advantage for own-race versus other-race faces. *Perception, 32,* 1117–1125.

Wright, D. B., Boyd, C. E., & Tredoux, C. G. (2001). A field study of own-race advantage in South Africa and England. *Psychology, Public Policy, and Law, 7,* 119–133.